International Journal of Civil, Structural,
Environmental & Infrastructure (IJCSEIERD)
ISSN(P): 2249-6866; ISSN(E): 2249-7978
Vol. 5, Issue 1, Feb 2015, 25-30

THE EFFECT OF CRUSHED ROCK POWDER AND SUPERPLASTICZER ON THE FRESH AND HARDENED PROPERTIES OF M_{30} GRADE CONCRETE

M. VIJAYA SEKHAR REDDY [1], D. MRUDULA[2], M. SESHALALITHA[3] & P. HARIPRASAD[4]

[1]Head and Assistant Professor, Department of Civil Engineering, Srikalahasteeswara Institute of Technology, Andhra Pradesh, India

[2, 3]Lecturer, Department of Civil Engineering, SrikaIahasteeswara Institute of Technology, Andhra Pradesh, India

[4]Assistant Professor, Department of Civil Engineering, Shree Institute of Technical Education, Andhra Pradesh, India

ABSTRACT

As the country becomes prosperous, there is a greater demand on upgrading infrastucture facilities that too at a rapid pace.There is already acute pressure on our natural aggregates in view of ever increasing population .The recycled aggregate technology and related issues including environmental impact are well understood. In US, Japan and Europe, this technology is being used quite efficiently and ecomomically. Thus, in India also it is becoming inevitable to use alternative materials for aggregates in concrete which include recycled aggregates, fly ash, manufactured sand, crushed rock powder etc. The use of such materials not only results in conservation of natural resources but also helps in maintaining good environmental conditions. This paper provides a solution for alternate construction materials for sustainable development by using quary dust (crushed rock powder) as fine aggregate replacement. A reference mix was proportioned by adopting IS 10262-2009 procedure for M_{30} grade concrete. The present experimental investigation aims in the study of the Workability and Strength properties of concrete made by replacing Fine Aggregate with Crushed Rock Powder at different percentage levels of 10%, 20%, 30%, 40%, 50% and 60%. In order to maintain the workability of concrete superplasticizer conplast was used.

KEYWORDS: Compressive Strength, Quarry Dust, Superplasticizer, Workability

INTRODUCTION

Concrete is one of the most widely used construction materials in the world, mainly due to its favourable features such as durability, versatility, satisfactory Compressive strength, cost effectiveness and availability. Now a days natural raw material are very scarce and increased cost of natural aggregates forces researchers to find alternatives to both coarse and fine aggregate in concrete. In this rapid industrialized world recycling of construction materials plays an important role. Quarry dust obtained from stone quarries poses a serious problem for disposal and by using quarry dust as fine aggregate disposal problem has been reduced and also its abundant availability reduces the cost of constuction.

The consumption of cement content ,workability,compressive strength,durability,Environmental pollution control and cost of concrete made with quarry dust were studied by many researchers, quarry dust fraction more than 40% of sand replacement it is advisable to use superplasticizers to improve the workability of concrete.[1][2] .

The workability of the concrete mix decreased with increased percentage of quarry dust.the reason is due to higher surface area [3]. The compressive strength strngth of concrete made with 40% replacement of sand with quarry dust

is more than that made with other percentage of replacement.[4].

Crushed Rock Powder is a material produced from the Quarrying of rocks. It is totally inert material and its physical properties are similar to natural sand. It is producing during the cutting of rocks. Generally, lot of tons of crushed rock powder is produced per day throughout India. This crushed rock powder is currently being used for many purposes ranging from landfilling to grit blasting. These applications utilize only about 15% to 20% and the remaining dumped as a waste material and this causes environmental pollution. Crushed Rock Powder is a fineness material with high specific gravity. Particle sizes are of the order of sand and have a potential for use as fine aggregate in concrete.

In order to reduce the accumulation of crushed rock powder and also to provide an alternate material for sand in cement concrete.The use of Crushed Rock Powder in cement and concrete provides potential environmental issues as well as economic benefits for all related industries. Several researchers have investigated the possible use of Crushed Rock Powder as fine aggregate in concrete and its effects on the different mechanical and long term properties of mortar and concrete. While most of the reports point to benefits of using Crushed Rock Powder as fine aggregate.

The use of sand in construction results in excessive sand mining which is objectionable. Due to rapid growth in construction activity, the available sources of natural sand are getting exhausted. Also, good quality sand may have to be transported from long distance, which adds to the cost of construction. In some cases, natural sand may not be of good quality. Therefore, it is necessary to replace natural sand in concrete by an alternate material either partially or completely without compromising the quality of concrete. Crushed Rock Powder is one such material which can be used to replace sand as fine aggregate.

EXPERIMENTAL PROGRAM

Materials Used

In this present investigation the following materials were used.

Ordinary Portland Cement (OPC) of 43 grade confirming to IS: 4031-1988 was used in all mixes. The fine aggregate used is locally available sand having fineness modulus of 2.44. The alternate material fine aggregate i.e. Quarry dust is collected fron stone quarries. Crushed Rock Powder used in this work was brought from Thottambedu Quarry near Srikalahasti. The quarry dust IS sieve 4.75mm passing materials is to be used, its fineness modulus is 1.68.the Table 1 shows the physical properties of the aggregates (fine and coarse) and the quarry dust. Locally available Coarse Aggregate having the maximum size of 20 mm was used. Portable Water is used for casting and curing of the specimens. The admixture used for attaining workability is superplasticizer CONPLAST. Use of supre plasticizer is more powerful dispersinng agents and high range water reducer.

Table 1: Properties of Fine Aggregate and Coarse Aggregate

S. No	Test Properties	Sand	Quarry Dust	CoarseAggregate
1	Specific gravity	2.6	2.65	2.75
2	Fineness modulus	1.68	1.68	7.4
3	Bulk density(kg/m^3)	1615	1765	1530
4	Water Absorption (%)	1	1.62	0.5

Mix Proportion and Specimen Preparation

Since there is no standard method of designing concrete mixes incorporating replacement of fine aggregate with

quarry dust, the method of mix design proposed by IS 10262:2009 was first employed to design the natural aggregate concrete mixes with percentage replacement (10%-60%) of natural fine aggregate by quarry dust in the concrete.

Cube specimen of 150mm size were casted for M_{30} grade for with natural coarse aggregate with sand and named as reference mix.Series of six mixes were prepared with the fine aggreggate replaced with quarry dust from 10%-60% to obtain required slump value superplasticizer has been used in the dosage levels of 0.2%-1% by weight of cement.

Table 2: Mix Proportion for M_{30} Grade Concrete

Cement (Kg)	Fine Aggregate (Kg)	Coarse Aggregate(Kg)	Water (lit)
413	693	1087	186
1.0	1.67	2.63	0.45

Table 3: Measured Slump for Various Mixes

Mix	M1	M2	M3	M4	M5	M6	M7
SP(%)	-	0.4	0.45	0.45	0.5	0.5	0.6
Slump(mm)	85	85	80	75	80	80	75

Testing of Specimens

Automatic compression testinng machime(ACTM) of capacity 2000 kN was used for testing the compression test of specimens. The test specimen were placed at the center of the loading platform of ACTM and tested under axial compression without any eccentricity. The load is increased graduallu at a rate of 5kN/Sec till crushing of specimens and load at which the specimens failed was taken as the ultimate compressive strength of concrete. Three specimens were test and aveage compressive strength of concrete was calculated.

RESULTS AND DISCUSSIONS

Table 3 gives the measured slump values for various mixes with different replacement levels of natural sand with quarry dust. It is clear from the table that the desire slump (as that of referrence mix) was achieved in all the mixes, in spite of higher water absorption of quarry dust.

The 28 days compresive strength of reference nix was **30.68 N/mm^2, were** as the mix M2 prepared with 90 % fine aggregate and 10 % quarry dust is found to exceed the strength of reference mix. This is due to the fact that quarry dust imparts high strength to the concrete mix.

Table 4: Compressive Strength for Various Mixes

Grade of Concrete	Crushed Rock Powder in %	7 Days Compressive Strengths in Mpa	28 Days Compressive Strengths in Mpa
M_{30}	0	19.48	30.68
	10	21.72	32.20
	20	23.26	34.84
	30	26.52	37.16
	40	30.34	39.04
	50	27.36	36.52
	60	25.48	31.98

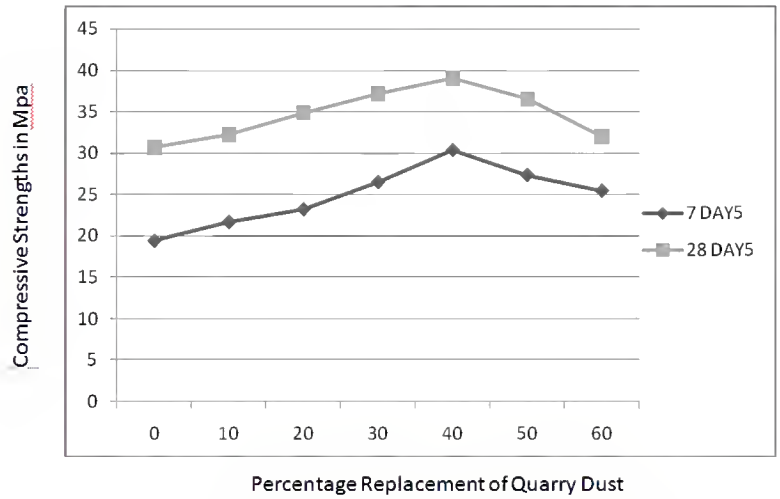

Figure 1: Variation of Compressive Strength for Different Replacements of Quarry Dust

CONCLUSIONS

- The workability of concrete mix decreased with increased percentage of quarry dust. The reason is due to higher surface area and higher water absorption of quarry dust.
- In order to improve the workability superplasticizer is added to concrete in dosage level of 0.2%-1%.
- The compressive strengths of concrete made with all the replacements of sand with quarry dust are exceeded when compared with the controlled concrete.
- There was a gradual increase of compressive strengths up to 40% and then compressive strengths were gradually decreased.
- The increse in the strength is attributted to the addition of quarry dust, which is assumed to be harder than conventional river sand. It is also concluded that quarry dust proves to be an effective material in enhancing the compressive strength of concrete.
- Based on the results the optimum percentage replacement of fine aggregate by crushed rock powder is 40%.
- The use of crushed rock powder as a partial replacement of sand in concrete not only results in conservation of natural resources but also helps in maintaining good environmental conditions and also reduces the scarcity of naturally available river sand and makes the concrete more economical.

REFERENCES

1. A.K.Sahu, sunil kumar and A.K.Sachan, crushed stone waste as fine aggregate for concrete, the Indian Concrete Journal, January 2003.
2. A.Krishnamoorthi, and G.Mohan kumar, Preliminary study on quarry dust concrete , Proceedings for Seventh Structural Engineering Convention
3. N.S Nadgir, S S Bhavikatti, stone quarry dust an alternative foe sand in concrete, second national conference on material and structures (MAST) 14-15 Dec 2007

4. A.Krishnamoorthi, R.Venkatakrishnaih, A.Narayanan, study of flyash based concrete with quary dust as a partial replacement to sand preocweeding of the 2nd natinal conferernce, department of civil engineering, Kong Engineereing College, on RTCCSS-07.
5. M.S.Shetty, concrete technology theory & practice, published by S. Chand & Company, Ram nagar, New Delhi.
6. A. Krishnamoorthi, and G. Mohan kumar, Preliminary study on quarry dust concrete, Proceedings for Seventh Structural Engineering Convention.
7. Satish Chandra, Waste Materials used in concrete manufacturing, a reference book.
8. IS: 383-1970: specifications for Coarse and Fine Aggregates for natural sources of concrete, Bureau of Indian standards, New Delhi.
9. IS: 10262-2009: Concrete Mix Proportioning-guidelines, Bureau of Indian Standards, New Delhi.
10. IS: 516-1959: Methods of tests for strength of concrete, Bureau of Indian standards, New Delhi.